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A Proposal for Synthetic Gauge Fields with Erbium in an Optical Lattice[1] LIN SU, ANNE HEBERT, AARON KRAHN, FURKAN OZTURK, MARKUS GREINER, Harvard University — Synthetic gauge fields enable the ultracold atom systems to probe interesting topological physics like the Quantum Hall Effect. Raman-coupling the magnetic sublevels (m_F or m_J) of the ground state manifold can give rise to synthetic gauge fields, as demonstrated by [1] using rubidium. Implementing this scheme using erbium in a site-resolved lattice can offer many significant improvements. The narrow transition will enable erbium to have more than an order of magnitude longer coherence comparing to alkali atoms, opening the gate to probe much longer time dynamics. Besides, since erbium's ground state can have up to $F = 19/2$, there are 4 times more sites than what is demonstrated with rubidium, offering much better defined edge states in a topological system. Moreover, the magnetic dipole-dipole interaction between erbium atoms offers a natural pathway towards many-body interacting physics, like the Fractional Quantum Hall Effect. Also, our experimental system features site-resolved imaging and sub-second BEC cycle time, which opens access to a new observable and empowers us to study systems that require a large number of statistics. [1] A. Celi, P. Massignan, J. Ruseckas, N. Goldman, I.B. Spielman, G. Juzelinas, and M. Lewenstein, Phys. Rev. Lett. 112, 043001 (2014).

[1]DARPA, AFOSR, NSF, ONR

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